REMARKS:

1) Section 9 on page 6 of the Final Office Action indicates that claims 5 and 6 contain allowable subject matter. However, claims 5 and 6 were rejected over the prior art in section 7 of the Office Action. In a telephone interview on February 9, 2006, the Examiner explained to the undersigned attorney that the indication of allowable subject matter of claims 5 and 6 was an inadvertent error, and thus section 9 on page 6 of the Final Office Action should be disregarded or stricken. The Examiner said that the Office Action should be answered on this basis.

2) Entry and consideration of this Response after Final are respectfully requested. The amendment cancels some claims, thereby reducing the number of claims, reducing the coverage of non-elected species, and reducing the issues remaining for appeal if necessary. Also, the amendment incorporates features from previously examined claims 23 to 25 into claim 1. Thus, the amendment does not raise any new issues that have not yet been considered and that would require further search or consideration. For these reasons, consideration of this Response after Final is appropriate, and is respectfully requested.

3) The claims have been amended as follows. Claim 1 has been amended to incorporate features from prior claims 23 to 25, as further supported in the disclosure of Figs. 1, 2 and 10, for example at page 11 lines 2 to 6 and page 17 lines 6 to 14. Claims 8 to 10 and 23 to 25 have been canceled. Thus, the

amendment does not introduce any new matter. Entry and consideration thereof are respectfully requested.

4) After the present amendment, claims 1 to 7 and 11 to 15 remain pending. Of those, claims 1, 3 to 6 and 11 to 13 read on the elected species of Fig. 10. Claims 2, 7, 14 and 15 remain withdrawn. In the event that a generic claim is ultimately found allowable, the Examiner is respectfully requested to rejoin, consider and allow the dependent withdrawn claims 2, 7, 14 and 15.

5) Independent claim 1 has been amended to recite two further features or limitations.

First, the barrier layer consists of a **single monolayer** of an i-type semiconductor material. Thus, claim 1 now expressly excludes arrangements in which the barrier layer involves a multi-layer arrangement or region.

Second, the barrier layer is provided between and respectively **directly in contact with** both the active layer and the p-type cladding layer. Thus, claim 1 expressly excludes all arrangements in which one or more additional layers are provided between the active layer and the barrier layer, or between the barrier layer and the p-type cladding layer.

Note that these features of amended claim 1 also represent distinctions between the elected species of Fig. 10 and the non-elected species of other figures as identified by the Examiner in the Species Election Requirement of May 25, 2005. For example, the species of Fig. 7 has an extra layer (namely the

trap layer) provided between the p-type cladding layer and the barrier layer. Thus, the Examiner identified Fig. 7 as being patentably distinct from Fig. 10. Furthermore, the species of Fig. 14 has no barrier layer provided between and directly in contact with the active layer and the p-type cladding layer. This also represents a patentable distinction between the respective species of Figs. 10 and 14.

Such patentable distinctions also exist between present claim 1 and the combined disclosures of the prior art, as will be discussed below.

These two features of the invention are also advantageous in comparison to the prior art, for example for the following reasons.

Regarding the first feature, namely that the barrier layer consists of a single monolayer, therefore the process of manufacturing the semiconductor device is greatly simplified in comparison to the required processing steps for manufacturing a device having a multi-layered barrier region. Furthermore, such a barrier layer consisting of a single monolayer achieves a steep gradient or change of the energy band gap between the barrier layer and the active layer. As a result, a sufficient carrier confinement effect can advantageously be achieved by this single barrier layer.

Furthermore, due to the second feature, whereby the barrier layer is directly in contact with the active layer, this allows the barrier layer to produce its maximum effect of carrier confinement. Namely, if a further layer having an intermediate energy level would be disposed between the barrier layer and the

active layer, then the above mentioned steep change of the energy band gap between the barrier layer and the active layer is lost, and instead there is a more-gradual transition of the energy level through the layers.

Still further, the second feature whereby the barrier layer is directly in contact with the p-type cladding layer allows an efficient hole injection from the p-type cladding layer into the active layer through the barrier layer (without any further hindering layers interposed therebetween).

With regard to these features of the invention, see the specification at page 5 line 11 to page 8 line 2 for example.

6) Regarding section 10 on pages 6 to 7 of the Office Action, and especially the second paragraph on page 7, the intended monolayer structure of the barrier layer has now been expressly recited and clarified in claim 1. Thus, applicants' previous arguments regarding the distinction between the present barrier (mono)layer and the prior art references disclosing a multi-layered barrier region, are now expressly pertinent to amended claim 1, and are incorporated herein by reference and reasserted.

7) Referring to sections 2 to 8 on pages 2 to 6 of the Office Action, the several prior art rejections of claims 1, 3 to 6, 11 to 13 and 23 to 25 have been obviated by the present amendment and are thus respectfully traversed. Amended independent claim 1 now includes features or limitations taken from prior claims 23, 24 and 25. None of the prior art rejections applied to all three of the claims 23, 24 and 25. Thus, no individual one of

the rejections would apply directly against present amended independent claim 1. Moreover, claim 1 is patentable over the prior art for the reasons that will be discussed next.

8) As discussed above, amended independent claim 1 recites two additional features that are not disclosed and would not have been suggested by the prior art.

According to the first feature, the i-type barrier layer consists of a **single monolayer** of an i-type semiconductor material. According to the second feature, the barrier layer is provided between and respectively **directly in contact with** both the active layer and the p-type cladding layer. The references do not disclose and would not have suggested such a combination of features.

US Patent 5,747,827 (Duggan et al.) discloses a multi-layered superlattice region (13) that forms a carrier confinement barrier (col. 8 lines 35 to 43). Duggan et al. do not disclose and would not have suggested providing a single monolayer barrier layer, and thus could not have provided or suggested the advantages of the present invention. For example, fabricating a multi-layered superlattice region is much more difficult and requires much higher precision and control of the quantum level while forming the several layers, in comparison to the inventive case of providing a single monolayer as a barrier layer. Namely, it is necessary to precisely control the thickness and composition of each one the many layers forming the superlattice region (13). Also, such a multi-layer superlattice region cannot achieve a sharp gradient or steep change of the

energy band gap, as is achieved by the inventive monolayer barrier layer. Thus, the carrier confinement effect would not be expected to be as good according to Duggan et al. in comparison to the present invention.

The Examiner has tacitly acknowledged that Duggan et al. do not disclose and would not have suggested a **monolayer** barrier layer, because prior claim 23 was not rejected in view of Duggan et al. as a primary reference.

Furthermore, Duggan et al. disclose an arrangement in which a guiding region (3) is provided **between** the confinement region (13) and the active region (2) (see Figs. 6 and 7). That teaches away from the inventive requirement that the barrier layer must be directly in contact with the active layer. In this regard, the Examiner has not rejected prior claim 24 as anticipated by Duggan et al., or using Duggan et al. as a primary reference.

US Patent 6,555,403 (Domen et al.) discloses an electron blocking layer or region (626), which is a multi-layer region including several graded layers (623, 624, 625) (see col. 53 lines 46 to 67 and col. 55 lines 5 to 7; see Figs. 38A and 38B). As discussed above, the fabrication of such a multi-layered region is more complicated than the fabrication of a single monolayer barrier layer according to the present invention. Also, such a multi-layered electron blocking region (626) including several graded layers cannot achieve a sharp or steep change of the energy band gap between the barrier layer and the active layer, in comparison to the present invention. Thus, the carrier confinement effect will not be as good as in the present invention.

Fig. 38B of Domen et al. expressly shows a band diagram having a gradual change or sloping transition of the band gap energy level between the blocking region (626) and the active layer (616). This sloping transition is clearly evident in comparison to the steep or sharp step-like band gap transition as shown for other layer interfaces in Fig. 38B. As a result, the carrier confinement effect of the blocking region (626) is reduced.

The Examiner has tacitly acknowledged that Domen et al. do not disclose and would not have suggested a monolayer barrier layer, because prior claim 23 was not rejected in view of Domen et al. as a primary reference.

Furthermore, Domen et al. disclose an arrangement in which a guiding layer (618) is interposed between the barrier region (626) and the p-type cladding layer (619) (see Fig. 38B). Namely, the barrier region is not directly in contact with the p-type cladding layer. That teaches away from the inventive requirement that the barrier layer must be directly in contact with the p-type cladding layer. In this regard, the Examiner has not rejected claim 25 in view of Domen et al.

Since Duggan et al. and Domen et al. both use multi-layer regions to achieve a carrier confinement effect, even a combination of the two references relating to a II-VI group compound semiconductor light emitting device would not have suggested the present single monolayer barrier layer. The references do not provide any suggestions in this regard. Furthermore, there would have been no suggestion that the barrier layer must be arranged directly in contact with both the active

layer and the p-type cladding layer. As discussed above, Duggan et al. provide a guiding region (3) between the confinement region (13) and the active region (2), and Domen et al. provide a guiding layer (618) between the barrier region (626) and the p-type cladding layer (619). Thus, a combined consideration of these two references would have suggested that a guiding layer or region should be provided on at least one side of the barrier layer, namely between the barrier layer and the cladding layer, or between the barrier layer and the active layer.

In the rejection of prior claim 23, the Examiner applied US Patent 6,870,178 (Asryan et al.) in combination with the above-discussed references of Domen et al. and Duggan et al. The Examiner asserted that Asryan et al. teach that the barrier layer is a single monolayer between the active layer and the cladding layer.

However, Asryan et al. disclose such a structure further including a quantum well layer (118) and an optical confinement layer (120) interposed between the barrier layer (116) and the p-type cladding layer (122). Thus, just like the above discussed disclosures of Duggan et al. and Domen et al., Asryan et al. do **NOT** suggest the presently claimed structure in which the barrier layer is arranged between and **directly in contact with** both the active layer and the p-type cladding layer. Thus, a combined consideration of all three references would have suggested that an optical confinement region or guiding region shall be interposed on at least one side of the barrier layer, namely between the barrier layer and the cladding layer, and/or between the barrier layer and the active layer. Such prior art

suggestions from all three references are directly contrary to the present invention in which the barrier layer must be directly in contact with both the active layer and the p-type cladding layer.

Still further, the Examiner has acknowledged that Asryan et al. do **NOT** disclose that the barrier layer is of i-type, and that the light emitting device is made of a group II-VI compound semiconductor material. In this regard, the Examiner has referred to Domen et al. teaching a group II-VI semiconductor, and Duggan et al. teaching either a group II-VI material or a group III-V material. Nonetheless, the teachings of the several references cannot be taken out of the context of these references. Namely, Asryan et al. disclose structures that particularly apply to a group III-V light emitting device. While Duggan et al. teach that there are group II-VI light emitting devices and group III-V light emitting devices, there is no teaching that the exact structures suitable for one group of semiconductor material will also be suitable for another group of semiconductor material. To the contrary, persons of ordinary skill in the art know that different semiconductor materials operate in different manners, and therefore require different structures. Thus, a person of ordinary skill in the art would not have considered (without further inventive activity) that a single monolayer barrier layer of i-type semiconductor material would have been suitable for a group II-VI semiconductor device, because Asryan et al. only teach the p-side barrier layer for a group III-V semiconductor device, while both Domen et al. and Duggan et al. teach multi-layer barrier regions in connection

with a group II-VI semiconductor device, as discussed above. Thus, a person of ordinary skill in the art would have considered it necessary to provide a **multi-layer** barrier region for a **group II-VI** device.

For the above reasons, even a combined consideration of all three references of Asryan et al., Domen et al. and Duggan et al. would not have suggested the present combination of features recited in independent claim 1. The dependent claims are patentable already due to their dependence.

The additional references of Migita et al. and Iwata are not pertinent because they were not applied against the features of prior claims 23 to 25, which have been incorporated into present amended claim 1.

For the above reasons, the Examiner is respectfully requested to withdraw the several prior art rejections.

9) Favorable reconsideration and allowance of the application, including all present claims 1 to 7 and 11 to 15, are respectfully requested.

Respectfully submitted,
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Transmittal Cover Sheet
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Form PTO-2038

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_____ 5/25/06
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